植物研究雑誌
J. Jpn. Bot.
74: 8–13 (1999)

Chromosome Numbers in *Itea* (Saxifragaceae, sensu lato)

Li-Ming NIU and Hideaki OHBA

Department of Botany, University Museum, University of Tokyo,
Hongo 7-3-1, Bunkyo-ku, Tokyo, 113-0033 JAPAN

(Received on March 6, 1998)

Chromosome numbers were counted in six species of *Itea*, four of which were examined for the first time. The somatic chromosome number of these species was 2n=22. The basic chromosome number x=11 was confirmed.

Key words: *Itea*, chromosome number

Itea is a small genus of about a dozen species (Hutchinson 1967) distributed from the Himalaya to Japan and eastern Malesia (the Philippine Islands) and disjunctly in North America. *Itea* has been considered to be monophyletic, but controversial in the way it is classified.

Engler (1930) and Schulze-Mens (1964) treated *Itea* in a monotypic subfamily of Saxifragaceae: Iteoideae Engl. Hutchinson (1967) placed *Itea* in the Escalloniaceae with *Choristylis* and 21 other genera. Takhtajan (1980) classified *Itea* in the Escalloniaceae but he considered that *Itea* and *Choristylis* differ from other members of the family in pollen morphology. Cronquist (1981) and Mabberley (1997) differed from them by placing *Itea* in the Grossulariaceae. Thorne (1992) recognized the subfamily Iteoideae (consisting of *Itea* and *Choristylis*) in Escalloniaceae. Broad generic level phylogenetic analyses of choroplast DNA restriction sites, *rbc*L, *mat*K and 18S rDNA sequences have been conducted on almost all genera of Saxifragaceae s. l. by Chase et al. (1993); Johnson and Soltis (1994, 1995); Soltis and Soltis (1997). Molecular phylogenetics has still been insufficient to elucidate the affinity and systematic position of *Itea*, although it has shown that some genera such as *Pterostemon* in Grossularaceae (sensu Cronquist) comprise a monophyletic group with *Itea*, notwithstanding that Grossularaceae are paraphyletic.

In general, cytological information is meaningful systematics, especially in clarifying taxonomic relationships of genera and species, and also by providing insights into speciation. In *Itea* and other genera cytological data are still insufficient. In *Itea* the chromosome number has been reported only from six species: *Itea chinensis*, *I. ilicifolia*, *I. macrophylla*, *I. nutans*, *I. parviflora* and *I. virginica.* Except for *I. nutans*, all the species studied have n=11 and 2n=22 chromosomes.

Recently we collected several species of *Itea* from Yunnan, Hubei and Taiwan provinces China and Japan, and observed their chromosomes. This study provides chromosome numbers and other remarkable cytological evidence for elucidating cytological features of the genus.

Materials and Methods

Most of the living plants used in this study

Table 1. Localities and voucher specimens of materials examined (all vouchers at TI)

Taxon	Locality	Voucher specimen	
I. ilicifolia	Yichang, Hubei, China	Li-Ming Niu	no. 93612
I. japonica	Takaoka gun, Kochi, Japan	Taku Miyazaki	s. n.
I. macrophylla	Buyuan, Xishuangbanna, Yunnan, China	Li-Ming Niu	no. 93556
I. oldhamii	Huangdidianshan, Taibei Xian, Taiwan	Chih-Hua Tsou	s. n.
I. riparia	Menxing, Xishuangbanna, Yunnan, China	Li-Ming Niu	no. 93515
I. yunnanensis	Lunan Xian, Yunnan, China	Li-Ming Niu	no. 93610

Table 2. The chromosome number of *Itea*

Taxon	Chromosome numbers		Sources of material	References	
	n	2n			
I. chinensis	11		Shillong, Khasia and Jaintia hills, India	Mehra & Khosla	(1969)
	11		Shillong, Khasia and Jaintia hills, India	Khosla	(1978)
I. ilicifolia	11		California, U. S. A. (cult.)	Bowden	(1940)
	11		California, U. S. A. (cult.)	Bowden	(1945)
		22	Yichang, Hubei, China	present study	
I. japonica		22	Takaoka gun, Kochi, Japan	present study	
I. macrophylla	11		Shillong, Khasia and Jaintia hills, India	Mehra & Khosla	(1969)
	11		Shillong, Khasia and Jaintia hills, India	Khosla	(1978)
		22	Buyuan, Xishuangbanna, Yunnan, China	present study	
I. nutans	11, 22		Shimla hills, Himachal Pradesh, Northern India	Sandhu & Mann	(1988)
	22		Suni, Himachal Pradesh, Northern India		
I. oldhamii		22	Huangdidianshan, Taibei Xian, Taiwan	present study	
I. parviflora	11		Yangmingshan, Taibei, Taiwan	Hsu	(1967)
I. riparia		22	Menxing, Xishuangbanna, Yunnan, China	present study	
I. virginica	11		Arnold Arboretum (cult.)	Sax	(1931)
		22	Kieler Botanischen Garten (cult.)	Schoennagel	(1931)
	11		North America	Bowden	(1940)
I. yunnanensis		22	Lunan Xian, Yunnan, China	present study	

were collected from four different localities in mainland China in 1993 and 1994. *Itea japonica* was collected from Shikoku, Japan, by Mr. Taku Miyazaki, and *I. oldhamii* was collected from Taiwan by Dr. Chih-Hua Tsou. All the materials were cultivated in the greenhouse of the Botanical Gardens, the University of Tokyo. The localities of the collections and voucher specimens are given in Table 1. The voucher specimens are in the Herbarium of the University of Tokyo (TI). Somatic chromosomes were observed in the meristematic cells of fresh root tips. Root tips were fixed in a 3:1 mixture of absolute ethanol and glacial acetic acid for one night after pretreating in 0.002M 8-hydroxyquinoline solution for 5–6 hours at room temperature (20°C). The root tips were hydrolyzed in 1N HCl at 60°C for 6–7 seconds, and immersed in distilled water. After maceration, they were stained in 2% aceto-orcein for 12 hours and then squashed.

Results and Discussion

Table 2 shows the chromosome numbers of

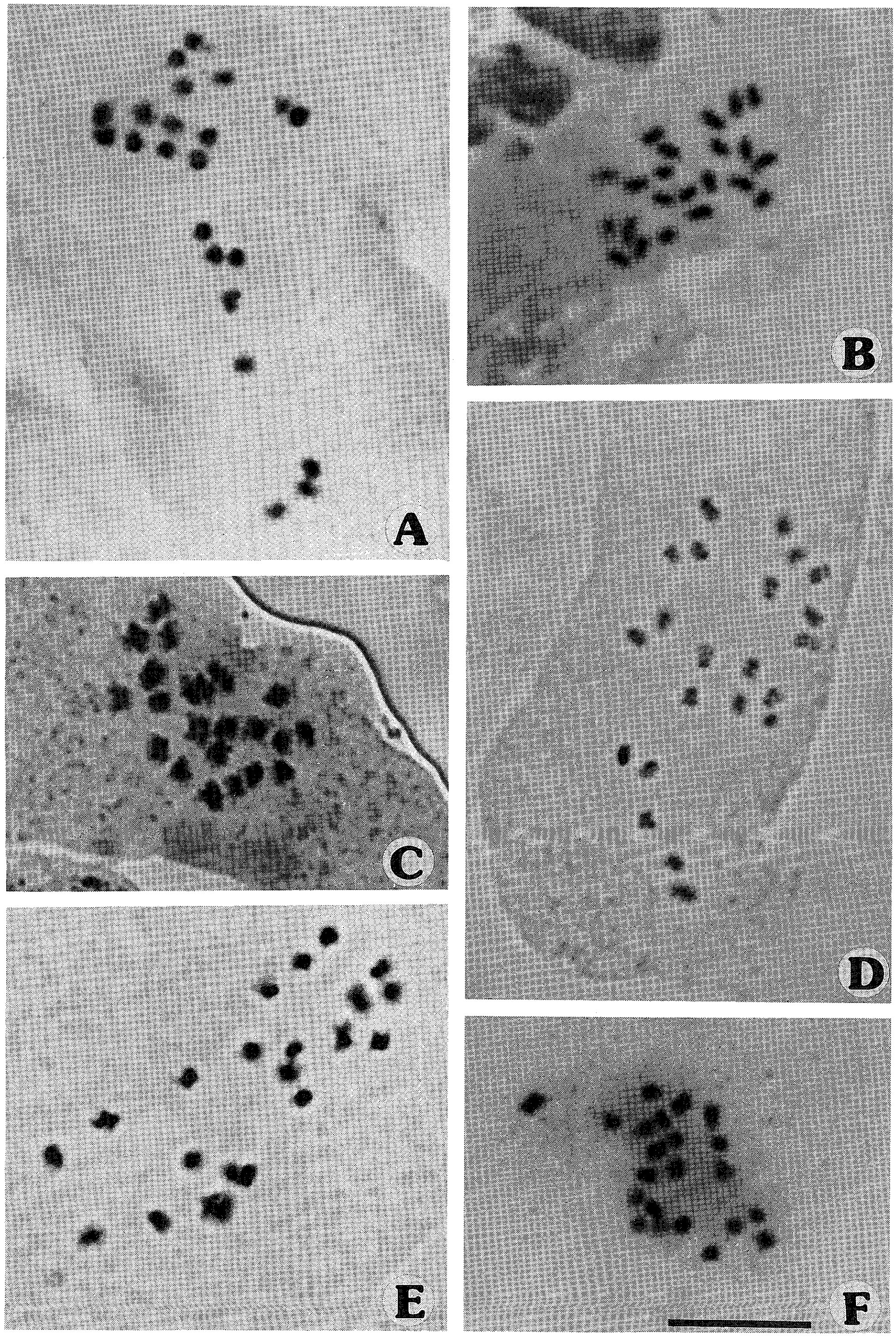

Fig. 1. Somatic chromosomes of *Itea*. A: *I. japonica* (2n=22). B: *I. riparia* (2n=22). C: *I. oldhamii* (2n=22). D: *I. yunnanensis* (2n=22). E: *I. ilicifolia* (2n=22). F: *I. macrophylla* (2n=22). Bar indicates 10 μm.

all species reported by previous authors and determined in this study. In this study, chromosome numbers were observed in six species, of which four were examined for the first time. The chromosomes of all the species investigated were very small, ranging from ca. 1.0 μm to 3.0 μm in length at metaphase. Karyotype analysis was not done because the chromosomes were too small.

1. *Itea japonica* Oliv.: 2n=22, Fig. A.

This species is distributed in western Japan, the only deciduous species found in Asia. The somatic chromosome number was examined for the first time.

2. *Itea riparia* Collett & Hemsl.: 2n=22, Fig. B.

This species is distributed in south central China, Shan State in Myanmar, northern Laos and northern Thailand, and is characterized by the persistent, narrow leaves, straight branches, large flowers, large capsules and ovoid seeds. The somatic chromosomes are small and homogeneous in size, the chromosome number was found to be 2n=22 for the first time.

3. *Itea oldhamii* C.K.Schneid.: 2n=22, Fig. C.

This species is distributed from the Nansei Shoto Islands (southernmost Japan) to northern Taiwan. It is similar to *I. chinensis* and *I. parviflora* in being evergreen, having axillary racemes, stamens longer than the corolla and a superior ovary, but differs from them by the luxuriant, coarsely dentate leaves. The chromosome number of *I. oldhamii* was examined for the first time.

4. *Itea yunnanensis* Franch.: 2n=22, Fig. D.

This species is distributed in south central China. The chromosome number was examined for the first time. The size of the chromosomes varied gradually from 1.0 μm to 2.3 μm in length.

5. *Itea ilicifolia* Oliv.: 2n=22, Fig. E.

This species is distributed in a limited area along the Yangtze River in western Hubei and easternmost Sichuan (including, Yichang [=Ichang] and Badong [=Patung]) in east central China. It is considerably similar to *I. yunnanensis*, but distinguished by the widely elliptic leaves usually with several large teeth, glabrous pedicels and glabrous calyx lobes. The haploid chromosome number of *I. ilicifolia* was reported as n=11 by Bowden (1940, 1945). We collected *I. ilicifolia* from the type locality in Yichang, Hubei Province, and observed 2n=22 chromosomes. The chromosomes resemble those of *I. yunnanensis* in size and size gradation, and can not be distinguished cytologically.

6. *Itea macrophylla* Wall.: 2n=22, Fig. F.

This species is widely distributed in India, Malesia, Indo-China, and the Philippines. The haploid chromosome number of *I. macrophylla* has been reported as n=11 by Mehra and Khosla (1969) and Khosla (1978). Their materials were collected from India. We counted the somatic chromosome number, 2n=22, from materials collected in southern Yunnan Province, China.

It is confirmed that the chromosomes number of the great majority of species in *Itea* is 2n=22 and the basic chromosome number is x=11, as reported by Sax (1931), Spongberg (1972), and Khosla (1978). Though Sandhu and Mann (1988) reported the haploid chromosome number n=11, 22 for *I. nutans*, we did not find any polyploidy or heteroploidy in this study. It is highly probable that all species in *Itea* are diploid. Cytological knowledge is still insufficient, however x=11 is known only from the herbaceous genera *Chrysosplenium*, *Fendlera*, *Peltoboykinia* and *Saxifraga* in the Saxifragaceae, s. l. The basic number, x=11, greatly differs from x=16 of *Ribes* in the Grossulariaceae.

Itea is classified into at least four groups based on branching pattern and some floral features. The *Virginica* group (sect. Itea [syn. sect. Deciduae Engl.]), consists of *I. virginica* and *I. japonica*. The *Nutans* group contains *I. nutans*, *I. yunnanensis*, *I. ilicifolia* and *I. riparia*. The *Chinensis* group contains *I. chinensis* and *I. parvifolia*, *I. omeiensis*, and the *Macrophylla* group contains *I. macrophylla*, *I. luzonensis*. In spite of gross morphological differences, no cytological difference was found among these four groups. We agree with Spongberg (1972) that *Itea* is probably homogeneous cytologically. Gross morphological differentiation may be more progressive than chromosomal differentiation in this genus.

We are grateful to Dr. M. Wakabayashi, Makino Herbarium, Tokyo Metropolitan University for his technical advice. We are greatly indebted to Professor Wu Su-Gong, Kunming Institute of Botany, Chinese Academy of Sciences, and Professor Ke Zhi-Guo, Wuhan Institute of Botany, Chinese Academy of Sciences for their help in our field survey. We wish to express our thanks to Dr. Chih-Hua Tsou, Institute of Botany, Academia Sinica, Taipei, and Mr. Taku Miyazaki, Miyajima Botanical Garden, Hiroshima University, who provided living materials from Taiwan and Japan.

References

Bowden W. M. 1940. Diploidy, polyploidy, and winter hardiness relationships in the flowering plants. Amer. J. Bot. **27**: 357–371.

——— 1945. A list of chromosome numbers in higher plants. II. Menispermaceae to Verbenaceae. Amer. J. Bot. **32**: 191–201.

Chase M. W., Soltis D. E., Olmstead R. G., Morgan D., Les D. H., Mishler B. D., Duvall M. R., Price R. A., Hills H. G., Qiu Y.-L., Kron K. A., Rettig J. H., Conti E., Palmer J. D., Manhart J. R., Sytsma K. J., Michaels H. J., Kress W. J., Karol K. G., Clark W. D., Hedrén M., Gaut B. S., Jansen R. K., Kim K.-J., Wimpee C. J., Smith J. F., Furnier G. R., Strauss S. H., Xiang Q.-Y., Plunkett G. M., Soltis P. S., Swensen S. M., Williams S. E., Gadek P. A., Quinn C. J., Eguiarte L E., Golenberg E., Learn G. H., Graham S. W., Barrett S. C. H., Dayanandan S. and Albert V. A. 1993. Phylogenetics of seed plants: An analysis of nucleotide sequences from the plastid gene *rbcL*. Ann. Missouri Bot. Gard. **80**: 528–580.

Cronquist A. 1981. An integrated system of classification of flowering plants. Columbia Univ. Press, New York.

Engler A. 1930. Saxifragaceae. *In*: Engler A. and Prantl K. (eds.), Die natürlichen pflanzenfamilien, 2nd ed. **18a**: 74–226. Wilhelm Engelmann, Leipzig.

Hsu C. C. 1967. Preliminary chromosome studies on the vascular plants of Taiwan (I). Taiwania **13**: 117–129.

Hutchinson J. 1967. The Genera of flowering plants. Clarendon Oxford Univ. Press, Oxford.

Johnson L. A. and Soltis D. E. 1994. *mat*K DNA sequences and phylogenetic reconstruction in Saxifragaceae s. str. Systematic Botany **19**: 143–156.

——— and ——— 1995. Phylogenetic inference in Saxifragaceae sensu stricto and *Gilia* (Polemoniaceae) using *mat*K sequences. Ann. Missouri Bot. Gard. **82**: 149–175.

Khosla P. K. 1978. Cytosystematics of some hardwood families. Nucleus **21**: 211–218.

Mabberley D. J. 1997. The Plant-Book: A portable dictionary of the vascular plants, 2nd ed. Cambridge Univ. Press, Cambridge.

Mehra P. N. and Khosla P. K. 1969. Saxifragaceae. *In*: Löve Á. (presented), IOPB chromosome number reports XX. Taxon **18**: 215.

Sandhu P. S. and Mann S. K. 1988. Iteaceae. *In*: Bir S. S. (ed.), SOCGI plant chromosome number reports – VII. J. Cytol. & Gent. **23**: 224.

Sax K. 1931. Chromosome numbers in the ligneous Saxifragaceae. J. Arnold Arb. **12**: 198–206.

Schoennagel E. 1931. Chromosomenzahl und phylogenie der Saxifragaceen. Bot. Jahrb. **64**: 266–288.

Schulze-Menz G. K. 1964. Saxifragaceae. *In*: Melchior H. (ed.), A. Engler's syllabus der pflanzenfamilien, pp. 201–206. Gebrüder Borntraeger, Berlin.

Soltis D. E. and Soltis P. S. 1997. Phylogenetic relationships in Saxifragaceae sensu lato: A comparison of topologies based on 18S rDNA and *rbc*L sequences. Amer. J. Bot. **84**: 504–522.

Spongberg S. A. 1972. The genera of Saxifragaceae in the southeastern United States. J. Arnold Arb. **53**: 476–480.

Takhtajan A. 1980. Outline of the classification of flowering plants (Magnoliophyta). Bot. Rev. **46**: 225–359.

Thorne R. F. 1992. Classification and geography of the flowering plants. Bot. Rev. **58**: 225–348.

鈕　力明，大場秀章：**ズイナ属の染色体数（ユキノシタ科）**

今回，ズイナ属（ユキノシタ科）6種，*I. ilicifolia*, *I. japonica*（ズイナ），*I. macrophylla*, *I. oldhamii*（ヒイラギズイナ），*I. riparia*, *I. yunnanensis*の染色体数を観察した．そのうちの4種，*I. japonica*, *I. oldhamii*, *I. riparia*, *I. yunncanensis*の染色体数はこれまで報告のないものである．調べたズイナ属全種の体細胞染色体は全て$2n = 22$であり，基本染色体数は$x = 11$であることが確認された．ズイナ属は2倍体種で構成されることが示唆できた．また東南アジアと北アメリカに隔離分布しているが，いずれの種においても染色体は小さく（長さ1.0 μm－3.0 μm），類似しており，核型解析は困難であった．ズイナ属は染色体数は全ての種で同一であり，多様性に欠けているが，形態学的形質により少なくとも4つの属内分類群が認められる（Ohba and Niu unpubl.）ほど，形態学的多様性が進んでいる．

（東京大学総合研究博物館植物部門）